Subject

BUNCHING THE BEAM IN THE STORAGE RINGS

For accelerating or decelerating of the stacked beam it is preferable to rebunch the stacked beam rather than employ phase-displacement acceleration since the bunching, acceleration and debunching processes can, in principle, be carried out with little or no loss of phase-plane density.

The minimum voltage required to hold a beam of original--unbunched--momentum spread $\pm \Delta p/p$ at a stable phase angle ϕ_S is given by

$$eV = \frac{\Delta p}{p}^2 \frac{\pi^3 hE\xi}{8\alpha^2} ,$$

where h is the harmonic number, E the total particle energy.

$$\xi = \left| \frac{1}{\gamma^2} - \frac{1}{\gamma t^2} \right| ,$$

and α is the bucket-area parameter, which is a function of ϕ_S.

We assume that

$h = 1$

$\xi = 0.44 \times 10^{-2}$ $(\gamma_t = 15)$

$E = 100$ GeV

$\sin \phi_S = 0.2$ i.e. $\alpha = 0.661$

and

$$\frac{\Delta p}{p} = \pm 2 \times 10^{-3}.$$

It should be noted that this is twice the momentum spread presently

considered the nominal stack-width. On the other hand, e.g., (1) cor-
responds to full buckets, without including any safety margins. The
first harmonic is chosen because it yields the lowest voltage. The re-
sulting voltage equals 15 kV.

This is a rather modest voltage, which should not be very difficult
to generate. It is true, though, that the frequency--143 kHz--is incon-
veniently low.

The average beam current is about 25 A. Due to the rather large
bunch length (sin ϕ_s = 0.2 and full buckets) the rf beam current loading
the cavity is about equal to the average current. Thus, the total reactive
power to be handled by the cavities is about 400 kVA.

This can be handled directly by the rf amplifiers or by detuning
cavities having sufficiently large stored energy, as discussed in Ref. 1.

The conclusion is that acceleration and deceleration in this storage
ring is comparatively easy, due to the rather small momentum spread of
the stacked beam.

REFERENCES

[1] W. Schnell, AR/Int. SG/65-26 (1965).